

**IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE**

Appl. No. : 10/765,647
Applicant(s): Laura Wills Mirkarimi
Filed: January 26, 2004
TC/A.U.: 1700/1792
Examiner: Duy Vu Nguyen Deo
Atty. Docket: 10030753-01
Confirmation No.: 1183
Title: Method for Etching High Aspect Ratio
Features in III-V Based Compounds for
Optoelectronic Devices

PRE-APPEAL BRIEF REQUEST FOR REVIEW

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In connection with the Notice of Appeal filed concurrently, Applicants respectfully request reconsideration of the application in light of the following remarks.

This paper includes (each beginning on a separate sheet):

1. Remarks/Discussion of Issues;

1. REMARKS / DISCUSSION OF ISSUES

Claims 1-20 are pending in the application. Claims 1 and 12 are the independent claims. Reference is made to the Response accompanying the RCE (RCE Response) filed October 31, 2007; and to the Response under Rule 116 (Rule 116 Response) filed on February 13, 2008.

Rejections under 35 U.S.C. § 103

Claims 1-20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Fathimulla, et al.* (U.S. Patent 5,338,394) in view of *Pearton, et al.* (Applied Physics Letters 60(7) (1992)). For at least the reasons set forth below, Applicants respectfully submit that a *prima facie* case of obviousness has not been established as to the rejected claims.

i. Claims 1 and 12

Claim 1 is drawn to a method of etching III-V semiconductor material, and features:

“...introducing a first gas chosen from HBr, HI and IBr into said reactive ion etching reactor; introducing a second gas of CH₄ into said reactive ion etching reactor; introducing a third gas of H₂; and exposing a portion of said III-V semiconductor material to be etched to a mixture comprising said first, said second and said third gas.”

As such, among other aspects, the method of claim 1 includes: introducing a first gas into an RIE reactor **and** introducing **methane (CH₄)** into the reactor **and** introducing **H₂**. Claim 12 is drawn to a method for etching a III-V semiconductor substrate and includes the noted features. Thus, **claims 1 and 12 each feature** the use of introducing 1. **HBr; and** 2. **CH₄; 3. and** H₂.

a. *Fathimulla, et al.* cannot be combined with *Pearton, et al.*

Applicants respectfully submit that the required suggestion or motivation to combine references is lacking because *Fathimulla, et al.* teaches away from its combination with *Pearton, et al.* Notably, there is no suggestion to combine if a

reference teaches away from its combination with another source: "A reference may be said to **teach away** when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant." *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994); *see KSR*, 127 S. Ct. at 1739-40 (explaining that when the prior art **teaches away** from a combination, that combination is more likely to be nonobvious).

A review of portions of *Fathimulla, et al.* relied upon in the rejection does reveal the use of **HBr** as an alternative to **SiCl₄** in a mixture of **CH₄**; or the use of **HBr** as an alternative to **SiCl₄** in a mixture of **H₂**. As such, the reference discloses the use **HBr and CH₄**; or **HBr and H₂**. Thus, with all three compounds at their disposal, *Fathimulla, et al.* **do not** direct one skilled in the art to combine all three, but rather direct one skilled in the art to limit the mixture to **HBr** and one or the other of CH₄ or H₂. As such, Applicants respectfully submit that one skilled would be not be led in a direction of the path taken by Applicants, but instead would be led in a direction divergent from the path that was taken by Applicants. Thus, Applicants respectfully submit that the reference to *Fathimulla, et al.* **teaches away** from the use of all three compounds, **HBr and CH₄ and H₂**. Because the reference to *Fathimulla, et al.* teaches away, its combination with another reference is nonobvious, and thus is improper.

b. *Pearton, et al.* cannot be combined with *Fathimulla, et al.*

As noted at page 5 of the Rule 116 Response, the Office Action concedes the lack of disclosure in *Fathimulla, et al.* of introducing **HBr and CH₄ and H₂**. In an attempt to remedy the shortcomings of the primary reference, the Office Action turns to *Pearton, et al.* However, *Pearton, et al.* explicitly **discourages** the combination of **CH₄ and H₂**. As noted at page 6 of the Rule 116 Response, *Pearton, et al.* states (with emphasis added):

"The **major limitation with the use of CH₄/H₂** discharges is the **slow etch rates**... [and] Several attempts to enhance the CH₄/H₂ etch rates by addition of Cl₂ (Ref. 9) and PCl₃ (Ref. 10) have been reported, but relatively high self-biases were needed to

achieve practical etch rates and careful seasoning of the reactor necessary for reproducible results.” (See page 838, left column.)

Furthermore, at page 839, right column, *Pearton, et al.* states (again, with emphasis added):

“With **CH₄/H₂ mixtures** at high microwave powers, the InP surface becomes rapidly deficient in phosphorous, and the morphology for even small (< 2000 Å) **etch depths is unacceptable.**”

So, if one were looking to supplement the two-gas mixture of HBr and CH₄ disclosed in *Fathimulla, et al.*, a study of *Pearton, et al.* would clearly discourage one from combining CH₄ and H₂. Therefore, one skilled in the art would be discouraged from introducing the compounds **HBr and CH₄ and H₂** as claimed.

c. Combination relies on hindsight

Applicants maintain their position that the rejection relies impermissively on hindsight. Kindly refer to pages 5 and 6 of the RCE Response.

ii. Response to Advisory Action

The Advisory Action includes various rebuttals of Applicants’ positions regarding the impropriety of the rejections. Applicants address these rebuttals presently.

a. Etch Rates

The Examiner rebukes Applicants’ position that *Fathimulla, et al.* teaches away by leading one skilled in the art in a divergent path from the path taken by Applicants. To wit, the Examiner states:

“Applicant’s [sic] pointing the slow etch rates of using CH₄/H₂ by *Fathimulla* is acknowledged. However, this is found unpersuasive because the slow etch rates are not a major concern of *Fathimulla*, who teaches to use other gases to achieve a smooth vertical surface...”

First, it would seem that the Examiner is discounting the discouraging of the use of CH₄ and H₂ as provided in *Fathimulla, et al.* because the teachings of *Fathimulla, et al.* are allegedly focused on other aspects of semiconductor processing. Respectfully,

Applicants submit that the ‘concerns’ of a reference are irrelevant to the present inquiry as they are not related to the path taken by Applicants and have no basis in the law as it relates to whether a reference teaches away. Rather, the inquiry is whether one skilled in the art at the time of Applicants inventions would have been discouraged from following the path set out in the reference, or would have been led in a direction divergent from that which is claimed upon review of a reference offered in combination in an obvious-type rejection. As the Examiner concedes, and as discussed above and in the 116 Response, the concerns raised in *Fathimulla, et al.* regarding the slow etch rates garnered by combining CH₄ and H₂ would have discouraged the artisan of ordinary skill from using this combination of gases, and would lead one skilled in the art in a direction divergent from the path taken by Applicants (i.e., introducing CH₄ and H₂ as claimed). For at least these reasons, Applicants maintain that the reference teaches away.

Second, the Examiner asserts that the etch rates can be enhanced by increased bias, among other things. This is discussed at column 3, line 65 through column 4, line 5 of *Fathimulla, et al.* The methods described in the reference as being used to enhance etch rates are only discussed in the context of enhancing etching with SiCl₄ and CH₄ or SiCl₄ and H₂; and no case is there even a suggestion of the enhancing etch rates using CH₄ and H₂. Moreover, there cannot possibly be such a teaching or suggestion of enhancing etch rates with the combination of CH₄ and H₂ because there is no teaching of etching with the combination of these gases in the first place. As such, the Examiner’s attempt to rehabilitate the teachings of *Fathimulla, et al.* that discourage the path taken by Applicants are misplaced and unfounded in law.

Conclusion

In view the foregoing, applicant(s) respectfully request(s) that the Examiner withdraw the objection(s) and/or rejection(s) of record, allow all the pending claims, and find the application in condition for allowance.

If any points remain in issue that may best be resolved through a personal or telephonic interview, the Examiner is respectfully requested to contact the undersigned at the telephone number listed below.

Respectfully submitted on behalf of:
Agilent Technologies, Inc.

s/William S. Francos/

by: William S. Francos (Reg. No. 38,456)

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